Washington State Conservation Commission and the Natural Resources Conservation Service

Report On Dust Storm of October 4 2009, In The Columbia Plateau and Columbia Basin

September 2010

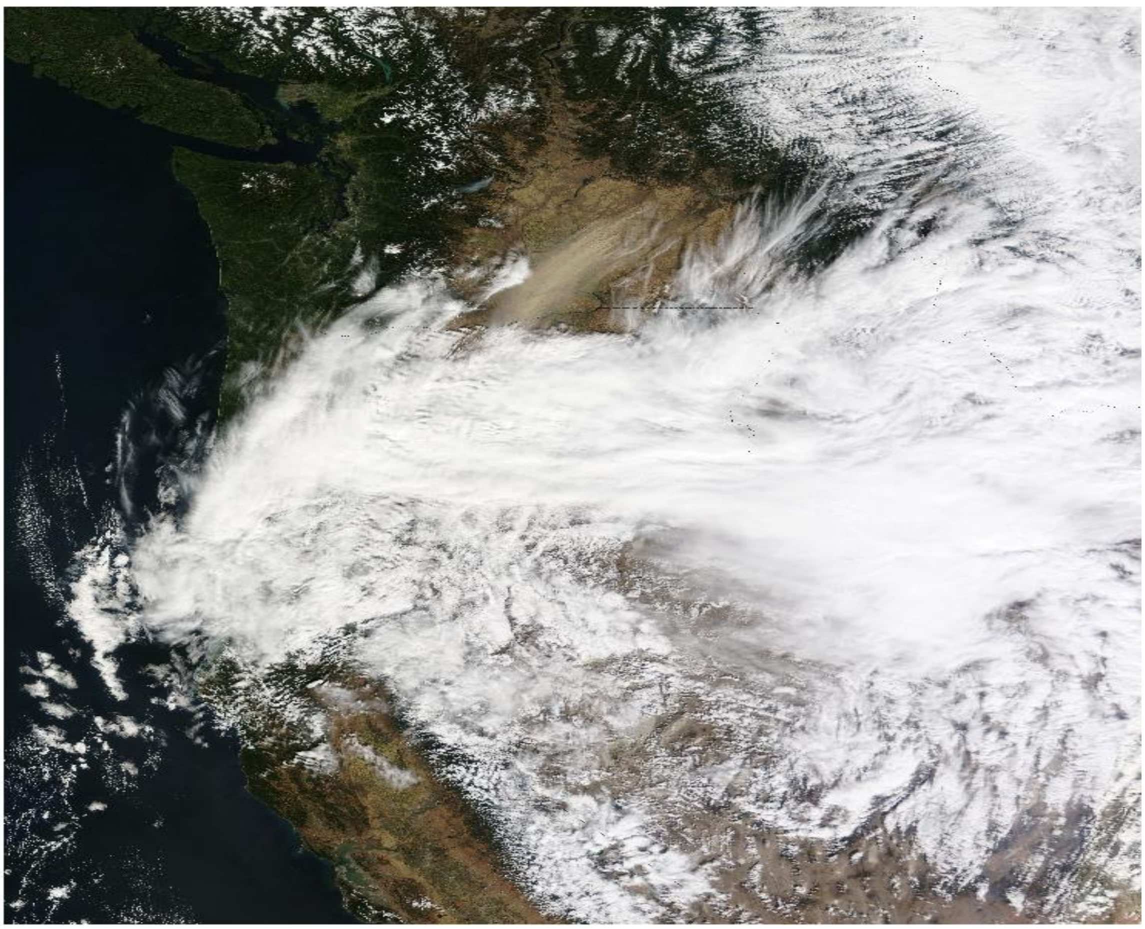

Figure 1. NASA IMAGE OF DUST STORM, LINK PROVIDED BELOW: http://earthobservatory.nasa.gov/images/imagerecords/40000/40590/wash_TMO_2009277_lrg.jpg

On October 4, 2009, a dust storm large enough to be seen from space stretched from the Columbia River to the Snake River, causing eleven injuries and closing I-90 for 20 hours in both directions. **See Figure 1.** Other highways and roadways in the region were closed after "uncounted accidents and mishaps," according to Spokane's Spokesman-Review. A five-car pile-up in Adams County resulted in injuries requiring air lifting to Spokane hospital, as well as totaling all five vehicles, including two semi tractor-trailers. More recently, on July 12, 2010, the fifth major dust storm in the Columbia Basin since March 29, 2010, caused at least two accidents west of Spokane. Winds gusting to 48 miles per hour "whipped up a dusty haze" and created a "plume of dust visible on satellite weather images" extending from Grant County eastward across Lincoln County. Spokesman-Review, July 13, 2010. The zero visibility condition caused by the dust plume forced the closure of several county roads and a state highway.

This report from the Washington State Conservation Commission and its partner agency, Natural Resources Conservation Service, reviews the causes of these recent dust storms and suggests possible conservation strategies to prevent such storms in the future.

The subject is complex and intensely studied. Included in this review is information from a variety of sources identified below, in particular two publications, Northwest Columbia Plateau and Columbia Basin Wind Erosion Air Quality Project, An Interim Report, WSU Misc. Pub. No. MISCO182, Ed. Keith E. Saxton (Feb. 1995) (referred to as "Saxton") and Farming With the Wind II, Columbia Plateau and Columbia Basin PM 10 Project Wind Erosion and Air Quality Control on the Columbia Plateau and Columbia Basin and Columbia Basin, by Robert I. Papendick, University Publishing, WSU (Feb. 2004) (referred to as "Papendick"). These publications are frequently quoted and cited.

I. BRIEF SUMMARY

Mostly out of necessity, farmers have learned to farm with the wind. Advances in conservation practices and agricultural machinery have made it possible for farmers to produce crops successfully in areas with a history of severe wind erosion. The chronic regional wind erosion events that were historically common throughout Eastern Washington have been reduced to what might be characterized as site specific seasonal events. When these wind erosion events do happen, the impacts can be significant, resulting in crop damage, public safety issues, and long term negative effects to the soil resources.

There is a need to open the discussion about where we go from here. In that discussion, a few critical questions need to be answered: Who is working on wind erosion? How will future technical and financial resources be allocated? Is identifying and targeting high priority treatment areas an option? Is research activity giving us tools for wind erosion control that the farming community can and will implement?

Most importantly, we need a collaborative plan to address the complex topic of wind erosion. A great deal of time and resources have been devoted to the development of tools and techniques for treating wind erosion. There is a commensurate need for a targeted implementation plan that would reduce wind erosion to tolerable levels in those areas determined to be the highest priority. Such collaboration could, for example, contribute to an updated Natural Events Action Plan (NEAP) focused on soil conservation methods to prevent dust events. At this time, the NEAP developed by Washington State University and the Department of Ecology in 2003 is inactive.

II. THE SIGNIFICANCE OF WIND EROSION

Topsoil may be lost in a few hours, but is exceptionally slow to rebuild. The geologic and biologic processes that create soil take centuries or more to complete. Papendick p. 73. The fine-silty soil, or "loess," found across the Columbia Plateau and Columbia Basin has been accumulating for one to two millions years. Saxton p.14. Across the United States, nearly seventy years since the Dust Bowl, wind erosion continues to threaten the sustainability of one of our nations' most essential natural resources.

Wind erosion physically removes the lighter, less dense soil constituents, such as organic matter, clays, and silts. It removes the most fertile part of the soil and lowers soil productivity. It has been estimated, for example, that topsoil loss from wind erosion causes annual yield reductions of 339,000 bushels of wheat and 543,000 bushels of grain sorghum on 0.5 million hectares (1.2 million acres) of sandy soils in southwestern Kansas. This loss in productivity has been masked or compensated for over the years by improved crop varieties and increased fertilization. However, increased fertilization increases economic costs. In the long run, the best economic solution is to keep topsoil in place, not to replant and fertilize a blown out crop.

A separate but related problem is air quality. Some soil from damaged land enters suspension and becomes part of the atmospheric dust load. Dust obscures visibility and pollutes the air. It fills road ditches where it can impact water quality. It causes automobile accidents, fouls machinery, and imperils animal and human health. Wind erosion is a threat to the sustainability of the land as well as to the viability and quality of life for rural as well as urban communities.

Losing topsoil in a dust storm, such as the October 2009 event, is not a recoverable loss. For all practical purposes, the loss is permanent. As a nonrenewable resource, topsoil is essential for sustaining an economic and productive agriculture for future generations. Soil loss by wind erosion destroys the capability and depreciates the value of the region's croplands for future agricultural use. The major croplands in the Columbia Plateau and

Basin that are most susceptible to wind erosion are shown in **Figure 2**, below.

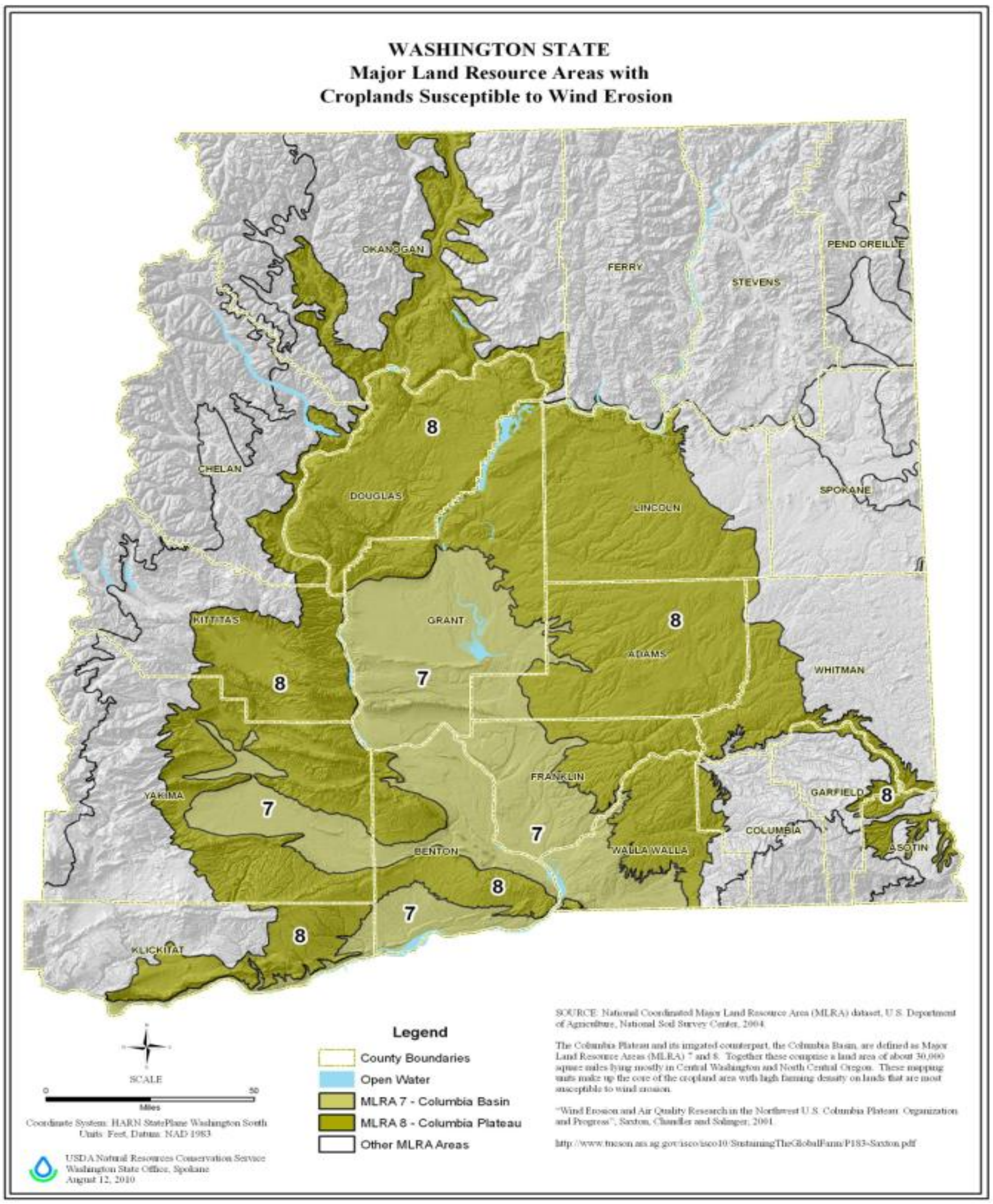

Figure 2. NRCS Map of Major Land Resource Areas with Croplands Susceptible to Wind Erosion.

III. BRIEF OVERVIEW OF THE CAUSES OF THE DUST STORM

On October 4, 2009, a windstorm from the northeast with sustained winds of up to 45 miles per hour for 20 hours lifted topsoil from a multi-county region as shown by the satellite photograph in Figure 1. The most soil loss occurred on recently-harvested potato fields that had not yet been replanted with cover crops, and recently planted dry land fallow fields that lacked post-plant surface residue and surface clods in sufficient quantity to provide adequate protection. Before wind erosion can occur, there must be a critical combination of (1) dry soil, (2) minimal soil surface protection from either live vegetation or crop residue, and (3) erosive wind energy.

This critical combination occurred in October of 2009. Potatoes were harvested late, irrigation water was not used, and no cover crop was planted to protect the soil. Thus, the soil was not protected against the wind. Traditional seedbed preparation often involves excessive tillage using aggressive tools that break down and bury crop residues and pulverize poorly structured soils, making them highly susceptible to wind erosion. As Papendick explains, "Wind erosion is most severe on irrigated lands during and after planting time in the spring and early fall before crops are established, and after harvest of late fall crops where little residue cover is left on the soil surface." Papendick p. 60.

Figure 3. Winter wheat field in the early spring with no conservation treatment

Overall, residue is the thread that runs through all discussions of soil erosion. Crop residue management is the "lynch pin for control of wind and water erosion in most farming systems." Papendick p. 75. Blowing dust from agricultural fields is an indication of farming practices that not only leave inadequate crop residue and roughness but also lack of soil structure and aggregation which provide natural resistance to erosion. Papendick p. 73.

IV. THE COLUMBIA PLATEAU AND COLUMBIA BASIN LANDSCAPE

Wind erosion is a serious problem for dryland and irrigated cropland in Eastern Washington that receive less than 12 inches of annual precipitation. **See Figure 4.**

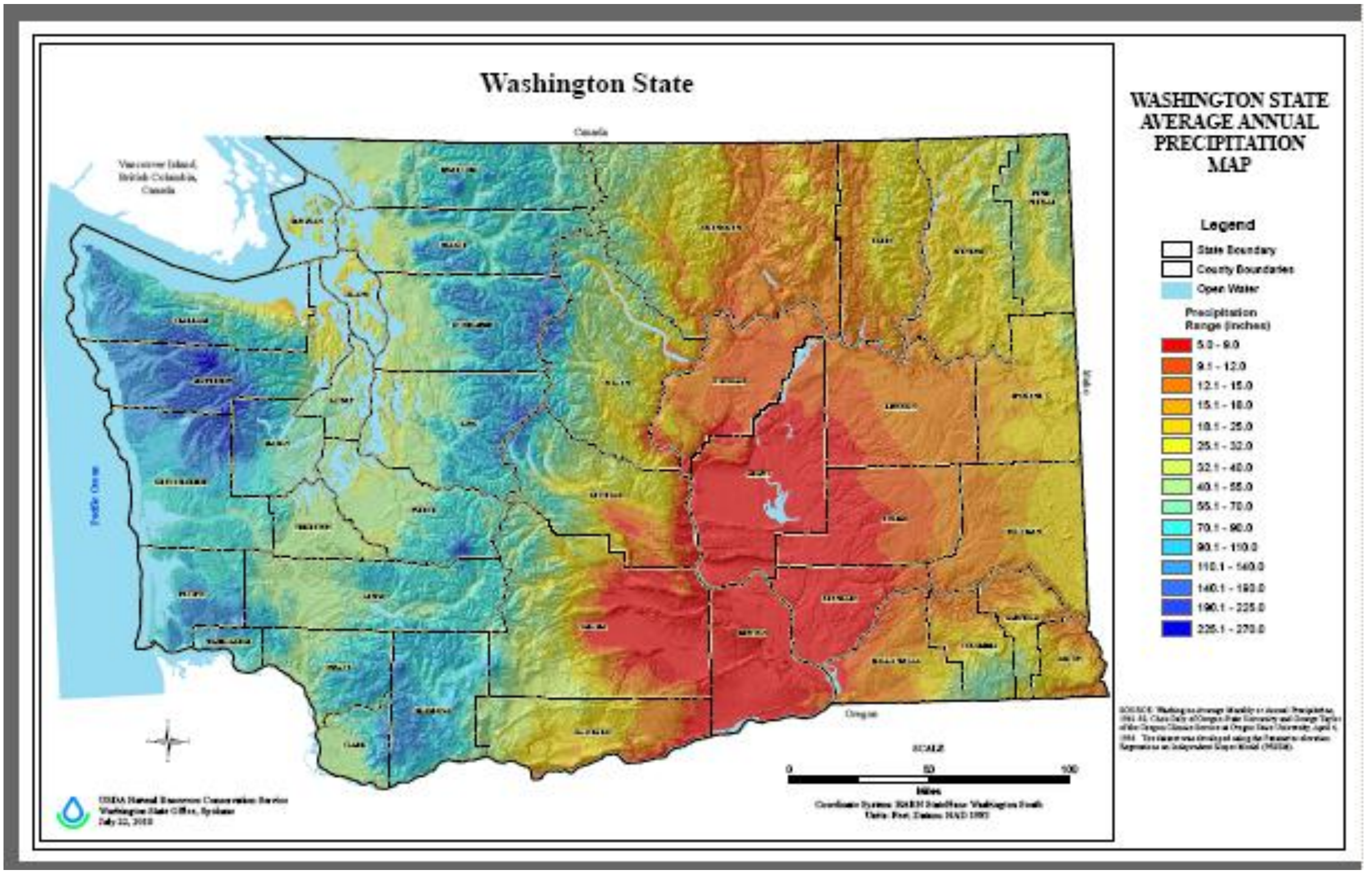

Figure 4. NRCS Washington State Average Annual Precipitation Map.

The seven counties that stretch across the low-precipitation region of the Columbia Plateau and Columbia Basin have both dry and irrigated croplands. Both are major concerns for wind erosion. Each contributes to "fugitive dust emissions." Papendick p. 76. Most of the cropland in Adams, Benton, Douglas, Lincoln, and Walla Walla counties is dry farmed, whereas a large percentage in Franklin and Grant is irrigated. **See Figure 5.**

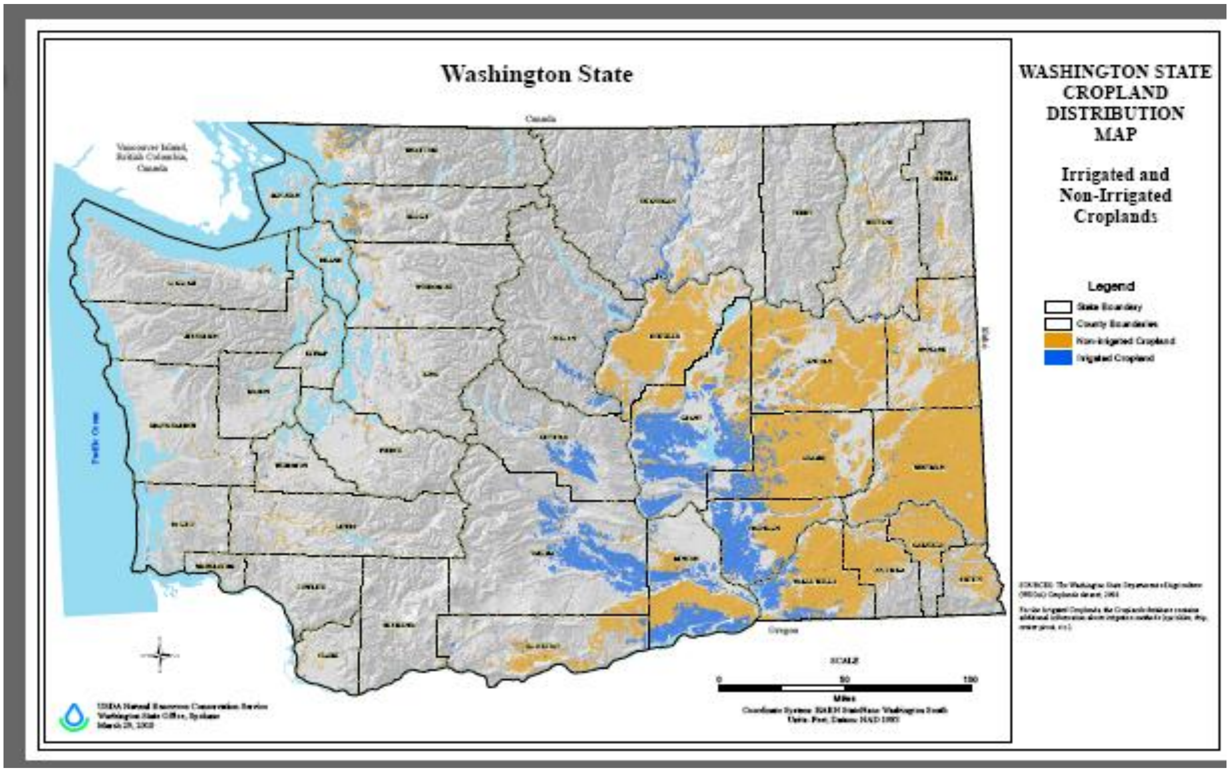

Figure 5. NRCS Washington State Cropland Distribution Map, Irrigated and Non-Irrigated Croplands.

V. SOIL CONSERVATION STRATEGIES FOR THE COLUMBIA PLATEAU AND COLUMBIA BASIN

There are several key factors that determine the potential for wind erosion: soil classification, soil condition, climatic zone, size of the field, position of the field, vegetative cover, crop residue, and farming methods. The challenge is to plan management systems that address three elements that the farmer can control: cropping systems, field layout, and farming practices. There may be situations where the soils, geographic location, climatic conditions, and crop limitations, make it difficult, if not impossible, to use conventional farming practices and meet quality criteria for soil erosion and air quality.

Where soil conservation is possible, the techniques and tools available to farmers are specific to the type of farming operation. Irrigated farmers have more practices, crops, and techniques available for controlling wind erosion than their dry land neighbors. Irrigated farmers have much more control of their cropping systems and can choose crops that protect the soil from wind erosion during those periods of the spring and fall when winds are greatest. A few of the practices and techniques available to both irrigated and dry land that have been proven to control wind erosion are:

(1) adjusting planting dates,

(2) residue management through conservation tillage,

(3) planting post-season cover crops,

(4) adding perennial crops to the rotation,

(5) using irrigation water to hold the soil during high wind events,

(6) planting perpendicular to the prevailing winds, and

(7) planting wind strips.

Conservation plans will typically use several of these practices in a conservation system. Such multi-faceted plans can take several years to fully implement.

Conservation strategies for irrigated cropland have focused on residue and cover crop management, making efficient use of water, and eliminating field burning. Conventional farming practices generally involve use of tillage implements such as the moldboard plow, heavy tandem disk, rotary tiller, and packer that destroy soil structure and leave the soil smooth, bare, and pulverized. New equipment is making it possible to maintain soil structure, preserve topsoil, and in some cases increase crop yield.

Cover crops are a practical means to control wind erosion after harvest of high soil disturbance crops such as potatoes or other crops like dry beans that leave very little surface residue. Winter wheat makes a good cover crop because seed costs are reasonable, it emerges quickly and produces rapid ground cover, is not killed by low temperatures, and withstands sand blasting during windstorms. Strip-till is a relatively new conservation farming technique where the tillage is confined to narrow strips where seed will be planted. Strip-till is gaining in popularity with irrigated farmers and is practiced in several crop-rotation scenarios. Corn, beans, and other crops can be strip-tilled into alfalfa in mid-to-late spring after the farmer obtains a first cutting of alfalfa hay. Farmers continue to develop innovative and sometimes elaborate methods of strip-till farming that are economically feasible and provide environmental benefits.

Dryland farmers do not have the same options available as irrigated farmers. Precipitation determines the timing and the type of crops they can grow. **See Figure 5.** They may be limited to dry land wheat with a summer fallow rotation, which means one crop every other year. In drought years, crop residue production is not sufficient to farm conventionally and still have sufficient residue 13 months later when the next wheat crop is planted. Farmers need to adopt management systems that provide maximum protection with minimum resources at hand. Direct seed, wind strips, chemical fallow, and barrier strips are excellent for wind erosion control, but are not widely popular with farmers.

Farmers may not have the equipment, finances, or expertise to make these changes. They may face the real prospect of decreased yields when transitioning to new management systems like direct seed. Farmers who are dedicated to making the transition typically overcome the obstacles and find that reduced operating costs make up for any loss in yield.   We have found this to be true with farmers in the Horse Heaven Hills in southern Benton

County. This area has the distinction of being one of the driest non-irrigated agricultural areas in the United States.

To summarize, for all croplands in the Columbia Plateau and Columbia Basin, the basic principles of wind erosion control are:

1. **Establish and maintain residue cover**
2. **Produce, through specific tillage operations, non-erodible soil surface conditions through aggregates or clods**
3. **Reduce field width along prevailing wind erosion direction**
4. **Manipulate the field configuration – strips, vegetative barriers**
5. **Manipulate crop rotations - primarily in irrigated cropland**
6. **Adopt conservation tillage practices – direct seed, under cutter method of wheat-fallow farming, chemical fallow where applicable.**

Eight more specific soil conservation strategies are listed below:

1. <u>Remove less productive ground from production for 10 years or more:</u>

The primary means of removal from production in the Columbia Plateau and Columbia Basin is through the Conservation Reserve Program, or "CRP." This is an excellent conservation method. With at least 10 years of perennial sod, wind erosion is reduced nearly to zero. **See Figure 6.** WSU is currently conducting trials for the "takeout" of CRP ground.

Figure 6. Field Edges Left In Native Habitat

2. Improve soil aggregation with organic carbon:

Organic carbon, partially decayed plant material or "humus," is important in helping to form soil aggregates or clods that resist win erosion. Saxton p.15. Organic carbon in the low-precipitation region of the Plateau and Columbia Basin varies from less than 0.5 percent to 1.5 percent. This range in values produces large differences in the ability of soils to form clods and resist erosion. No-till practices result in increased soil carbon content. Papendick p.75.

3. <u>Increase crop residue:</u>

In general, the best practice is to maintain at least "30% minimum residue cover after seeding and supplement with surface roughness." Papendick p. 31. The recommended percentage has been as high as 80% in the past. The minimum residue cover to prevent wind erosion varies depending on slope and other site specific factors.

(a) <u>For dry cropland,</u> the best practices to increase residue include:

(i) minimum tillage using the undercutter method or, if applicable, no-till planting,

(ii) increased cropping intensity, if applicable,

(iii) retention of maximum quantities of surface residue, and

(iv) those practices that leave soil surface rough or that improve soil aggregation. Papendick p. 7.

(b) <u>For irrigated land,</u> in addition to the practices listed above, the best practices to increase residue include:

(i) maintenance of year-round surface cover

(ii) use of synthetic soil stabilizers

(iii) planting vegetative barriers

(iv) strip cropping

(v) planting tree windbreaks.

Figure 7. Field Edges And Center Pivot Corners Planted to Perennial Grass

4. Minimize surface disturbance:

Tillage variations that retain clod size and surface residue cover result in soil conservation during wind events. Saxton p. 27. Maintaining fallow with procedures that focus on minimal surface disturbances can effectively reduce erosion even on highly erodible sandy soils. Id.

5. Reduce wind velocity at the soil surface:

Windbreaks or roughened soil surface reduce wind velocity at the soil surface, thus reducing wind erosion. Windbreaks include trees, shrubs, and grasses. Saxton p. 41. Conifers use less water than deciduous, thus may be more suitable as windbreaks on the Columbia Plateau and Columbia Basin. Saxton p. 42. Double rows of tall perennial grasses have been shown to reduce wind erosion where insufficient water is available to grow trees. With small grains, leaving 10 or more inches of residue standing is an effective method of reducing wind velocity at the surface.

Figure 8. Early Spring Potato Field – Planted Perpendicular to the Predominant Wind Direction.

6. Experiment with timing of planting, harvesting and cover cropping of potatoes and similar crops:

For potatoes, early harvest allows cover crops to be planted and take root. Green manure cover crops may be used after potato harvest. Cereal crops that provide soil cover could provide fall and spring forage for livestock and wildlife. Saxton p. 43. For onion producers, planting grain strips with or ahead of planting onions protects seedlings from wind damage and reduces field wind erosion. “This practice is low cost and may have potential for use with other high value crops.” Papendick p.58.

Figure 9. Potato Field without Cover Crop - High Wind Erosion Potential

7. Experiment with planting, rotation, and cover cropping of winter wheat:

Sowing winter wheat in mid-to-late August maximizes straw and grain production for winter wheat-summer fallow. No-till spring barley or spring wheat can sometimes be economically viable in lieu of summer fallow following winters of above-average precipitation.

Winter wheat and Mustard can provide effective cover on irrigated land for most high wind events if sown by September 1.

Figure 10. Post-Season Potato Field with Cover Crop - Low Wind Erosion Potential

8. **Experiment with new equipment, such as new deep furrow drills:**

New technology or expanded use of existing technology includes deep furrow drill development and the use of undercutters to increase cover and standing stubble. Under cutters can replace other implements that bury residue and pulverize clods.

VI. OBSTACLES TO SOIL CONSERVATION

The primary reasons given by growers for not adopting soil conservation practices are:

(1) Inadequate seed-zone moisture for early planting with chemical fallow .

(2) Difficulty in controlling grass weeds.

(3) Plugging of grain drills due to excessive residues.

(4) Financial risk in converting to conservation farming systems.

Note: In a 6-year field study of winter wheat-fallow systems, conventional tillage showed no agronomic advantages over the minimum tillage and delayed minimum tillage fallow using the undercutter method in terms of weeds, diseases, and grain yields. Papendick p. 33. The yields for the minimum tillage treatment exceeded or equaled those for the conventional treatment each year. "The economic data clearly indicate that the potential soil erosion control benefits of the two BMP systems were obtained without foregoing any profit." Id.

(5) Lack of education

A survey showed that 60.5% of the 266 farmers surveyed were "zero practice adopters." Among the 40% who had adopted one of more of the conservation practices surveyed, the only significant commonality was education and farm size. Papendick p. 80. We need to take a fresh look at a continuing education or certification program for farmers in erosion-prone areas. In addition, we need more government farm programs to provide incentives for conservation farming.

(6) Contract limitations

For contract crops, like potatoes, growers must operate according to the terms of written contracts. In the case of potatoes, where a grower is leasing land, and where the lease period ends with harvest, there is a potential gap in land management at exactly the time when the most severe wind storms may occur. This may have happened on October 4, 2009.

VII. CONSEQUENCES OF NON-ACTION

"A nation that destroys its soil destroys itself." Franklin D. Roosevelt's words are as true today as they were 75 years ago. In the Columbia Plateau and the Columbia Basin, the loss of soil over time will destroy a nonrenewable natural resource that is essential to food production and to our state's agricultural economy.

Other consequences are increased air quality regulation by the federal government. An EPA determination of non-attainment would result in increased restrictions on those practices that result in fugitive dust.

At the state level, there is legal liability for damage to property as well as liability for injury or death resulting from fugitive dust. Fingerprinting of dust sources makes it possible to trace dust that has caused damage or injuries back to the field and thus to the owner or operator of that field.

Over 150 books, book chapters, and journal articles on wind erosion and control of blowing dust from agriculture fields have been published since 1993 by Washington State University and the USDA-ARS scientists with funding provided by the Columbia Plateau PM10 Project. These publications are available for download at no cost at http://pnw-winderosion.wsu.edu/.

Sources of Information:

This was written by Lynn Bahrych, Chair, WSCC, and Harold Crose, Central Area Conservationist, NRCS, with assistance from Commissioner Tracy Erikson and Dr. Bill Schillinger, of Washington State University, using the following primary sources.

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3. Spokane Spokesman-Review, October 4, 2009, October 5, 2009, July 13, 2010.

4. Area Conservationist Harold Crose, NRCS, Field Trip March 14, 2010, Adams County

5. Commissioner Rudy Plager, Interview March 15, 2010.

6. Dr. Bill Schillinger, Guest Lecturer on October 4, 2009, Dust Storm and Current Research in Deep Furrow Drill, WSCC Work Session, March 18, 2010.

7. WSU Tour of tillage equipment and conservation practices, Pullman, May 2010.

8. Washington State Dept. of Ecology Columbia Plateau Windblown Dust Natural Events Action Plan, 2003 (available online).